

*Upper Susquehanna River Watershed-Cooperstown Area Ecosystem
Restoration Feasibility Study and Integrated Environmental Assessment:
Post-Restoration Water Quality and Wildlife Analysis of the FABADS Sites
(2003-2004)*

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EXECUTIVE SUMMARY

The *Field Assessed Benefit and Design Strategy* (FABADS) was introduced by the U.S. Army Corps of Engineers as part of the *Upper Susquehanna River Watershed-Cooperstown Area Ecosystem Restoration Feasibility Study and Integrated Environmental Assessment*. Authorized by the U.S. Congress, the pilot program is “to conduct a study and develop a strategy for using wetland restoration, soil and water conservation practices, and nonstructural measures to reduce flood damage, improve water quality, and create wildlife habitat...” The strategy implemented includes site identification, quantification of the water quality and wildlife benefits achievable through wetland restoration, and application of conclusions drawn from the data to future restoration designs. The FABADS concept takes the necessary and practical steps to bridge the gaps between theory, application, environmental impact and adaptive management.

In 2001, data recovered by the working team during the reconnaissance phase of the study identified 8 FABADS sites in Otsego County, NY. These are the physical locations of the “degraded” wetlands under ownership by private citizens agreeable to wetland restoration efforts. In 2002, the FABADS sites were surveyed, designed, and constructed under the oversight of the not-for-profit NGO Ducks Unlimited, Inc. In general, the overall design for all the FABADS sites was to create an earthen berm at each site that served to capture and restrict aboveground flow.

In 2003 the SUNY College at Oneonta Biological Field Station began the study with pre-restoration monitoring of 2 FABADS sites and a naturally occurring Reference wetland. Additionally, four sampling sites along the Susquehanna River were monitored in an attempt to capture the watershed-scale effect of the FABADS site restorations. Currently the study includes monitoring through November 2004 (one year post-restoration) and focuses on the ability of the restored sites to recover from the disturbance of restoration and provide the water quality and biodiversity benefits expected. Water quality data collected over the past seven years from the Upper Susquehanna River Watershed is also provided.

The study addresses three fundamental questions: (1) is water quality improved after restoration of the site, (2) did the restoration result in an increase in biodiversity of wetland species and (3) are water quality benefits measurable at the watershed-scale.

Results, summarized below, form the basis for recommendations on how to improve the restoration process.

Site 1, formerly an active cow pasture, had nutrient values well above those recorded at the Reference site. However, Site 1 showed an increased capacity for nutrient retention for all parameters post-restoration and recorded positive average retention efficiencies during rain events and baseflows. From June to November 2004, Site 1 retained 180 kg of nitrogen, 6.5 kg of phosphorus and 584 kg of sediment during baseflow. Site 2, formerly a vegetated wet meadow surrounded by agriculture, had some nutrient values below those recorded at the Reference site (nitrate, total phosphorus, fecal coliform bacteria and total suspended solids) while others were above or similar over the monitoring period (total nitrogen and ammonium). Except for nitrate, Site 2 showed either a decreased capacity for nutrient retention (ammonium, total phosphorus and total suspended solids) or little change overall (total nitrogen and fecal coliform) when comparing pre and post-restoration values. Although Site 2 had positive retention efficiencies for all parameters during rain events, it acted as a source for all parameters (except nitrate) during baseflow. From April to November 2004, Site 2 exported 29 kg of nitrogen (in the form of NH_4 and organic N), 5.00 kg of phosphorus and over 300 kg of sediment.

Overall, plant biodiversity was greater at the restored sites than at the Reference site. However, Site 1 had fewer wetland species and wetland species averaged less than half the % cover compared to the Reference. Site 2 had a similar number of wetland species and % cover compared to the Reference site. Avian biodiversity increased at both restoration sites, with the number of species and frequency of occurrence of waterfowl and wading bird species more than tripling after restoration. The number of waterfowl/wading bird species at the restored sites was also 3 times higher than at the Reference site. The number of song birds, although less than the Reference, also increased at both sites post-restoration. Additionally, while post-restoration amphibian/reptile biodiversity only saw a small increase at Site 1, Site 2 saw an increase in the number of species observed from 0 in 2003 to 5 in 2004. However, both sites had fewer species than the Reference and fewer individual observations.

Overall, the results demonstrate that the pre-restoration decision making process resulted in wetland restoration techniques that had varying degrees of success. Many of the benefits appear to be strongly influenced (both positively and negatively) by initial site conditions. For example, water quality improvements seem achievable at sites where significant degradation already exists. Alternatively, where initial water quality is relatively good, first year results reflect the disturbance of restoration. Improvements in water quality will depend on the development of the biological communities and physical conditions that represent the pools and pathways of nutrient retention. Not independent of this, increases in biodiversity will also depend on the ability of wetland species to immigrate to and successfully inhabit the restored sites over time.

The ability to make accurate, long-term predictions of the trajectory of wetland development regarding nutrient retention and biodiversity is seriously limited by the

preliminary nature of the data. Nevertheless, the *Field Assessed Benefit and Design Strategy* is an adaptive approach that enables decision makers to augment policy in the light of new quantitative data. The following are suggested recommendations based on the observed environmental impact of current practices and are meant to improve the efficiency of future Army Corps of Engineers wetland restoration policy in the Susquehanna River watershed.

- *Timeframe and timetable* - The FABADS assessments are meant to be the basis for adaptive management decisions regarding future restoration design. This study represents only the earliest stages of wetland development or year 1 of a post-restoration development process that is likely to last decades. If the wetland restoration process is to be adaptive and results of the study are to be used effectively, then the timeframe of the study should be expanded and assessment of the expected benefits ought to be continued for a reasonable duration. This would serve to increase the validity of the rationale used in past and future decisions, increase the confidence in the predictive value of data gathered and reinforce the link between management actions and environmental impacts.
- *Site Selection* - Despite the relative brevity of the study to date, results one year post-restoration do highlight some areas of the restoration process that should be continued and others that could be enhanced. Site selection should include preliminary water quality and soil nutrient analysis and focus on those sites that have the high nutrient export characteristics of agricultural land use and commercial/municipal waste water. Also, for those cases where water quality degradation may take place in conjunction with increases in biodiversity and to help define programmatic success, the relative value of nutrient retention versus increases in biodiversity should be decided.
- *Design and Construction* - Restoration sites should be placed proximate to nutrient sources, removing all nutrient rich soils, *i.e.* from manure enriched feed lots and pastures, from contact with throughflowing water by sequestering them inside the constructed berm (as with Site 1). Where appropriate, access to restored areas should be limited (particularly from livestock) and additional best management practices, such as riparian buffer zones, should be implemented to protect the site from future degradation and to further enhance nutrient retention. The area of shallow water (<18 inches) near the inflow of the wetland and around its perimeter should continue to be maximized and deeper portions (6-8 ft) near the outflow should continue to be created. This will facilitate some biogeochemical processes that are responsible for nutrient retention and create a suitable environment for the emergent aquatic vegetation that serves as a resource for all other trophic levels. If feasible, soil from sites where seed banks are composed of desirable wetland species should be transported to sites where seed banks are composed largely of upland species. Finally, outflowing structures that draw water at depth should be replaced by those that draw from the surface. This would help maximize the process of sedimentation and possibly avoid water that may be anaerobic and therefore likely to release in TP and NH₄.

- *Study* - Finally, to strengthen the connection between wetland restoration decisions and environmental impacts, the amount of site specific data should be increased. This can be achieved by shifting study resources away from efforts which attempt to capture watershed scale responses to restoration to those which would
 - investigate new parameters (such as flood retention) at existing FABADS sites
 - investigate the condition of sites currently under consideration
 - identify high value (high nutrient/low biodiversity) sites within the watershed for future restoration.

Water quality data collected over the past seven years from the Upper Susquehanna River Watershed (*i.e.* northern tributaries, Otsego Lake and the Upper Susquehanna River) are summarized below.

Average total phosphorus concentrations in the five major tributaries that supply Otsego Lake have changed significantly since 1998. Average 2004 nitrate concentrations, although not statistically significant, show the first decline in 6 years. Numerous agricultural Best Management Practices implemented along one of the largest of these tributaries (Shadow Brook) have yet to result in any significant changes in water quality.

During the summer of 2004, Otsego Lake had mean chlorophyll *a* concentrations (indicative of algal standing crop) that were among the lowest ever recorded but other physical and chemical trophic indicators show a slight shift toward more eutrophic conditions following several years of improvement. Similarly, 2004 average nutrient concentrations in the Susquehanna River either rose to, or maintained, a level that keeps them among the highest recorded in seven years.

Watershed-scale water quality analysis provides statistically rigorous analysis that allows for the assessment of ongoing remedial measures. Validation of these programs not only has significance at a local level by informing policy makers regarding the environmental impacts of these projects, but also on a larger scale where quantitative support plays a key role in the implementation of similar measures.